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Mannepalli et al.

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(54) **SYSTEM AND METHOD FOR REAL TIME OPTIMIZATION OF DRIVING DIRECTIONS**

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G01C 21/34 (2006.01)
G01C 21/36 (2006.01)

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CPC ***G01C 21/34*** (2013.01); ***G01C 21/3691*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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Primary Examiner — Redhwan K Mawari
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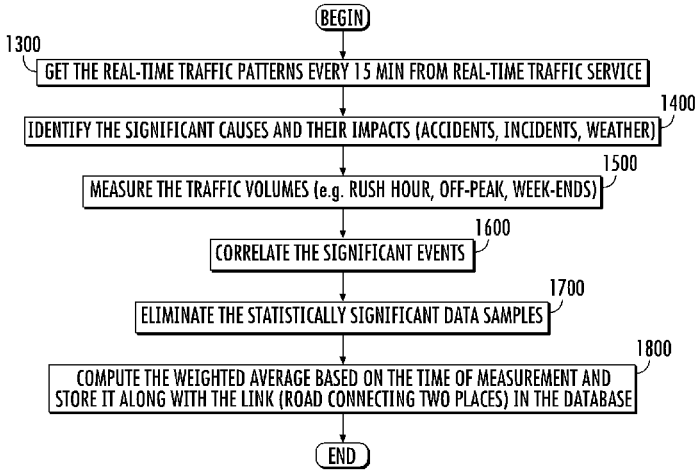
(74) *Attorney, Agent, or Firm* — Howard IP Law Group, PC

(57) **ABSTRACT**

A system and method for generating driving directions is disclosed. The system and method comprise generating a series of instructions to guide a driver along a route that includes a sequence of roads and intersections. The system uses real time or near real time information culled from one or more databases to calculate and display a time-efficient route based on current weather conditions, traffic conditions, road closures, construction, and the like. The system can also incorporate one or more driver preferences in calculating the displayed route. The system also can provide a summary of the rationales used in calculating the displayed route so the user can understand the basis for a particular route's presentation. A method is also disclosed for using the system.

18 Claims, 9 Drawing Sheets



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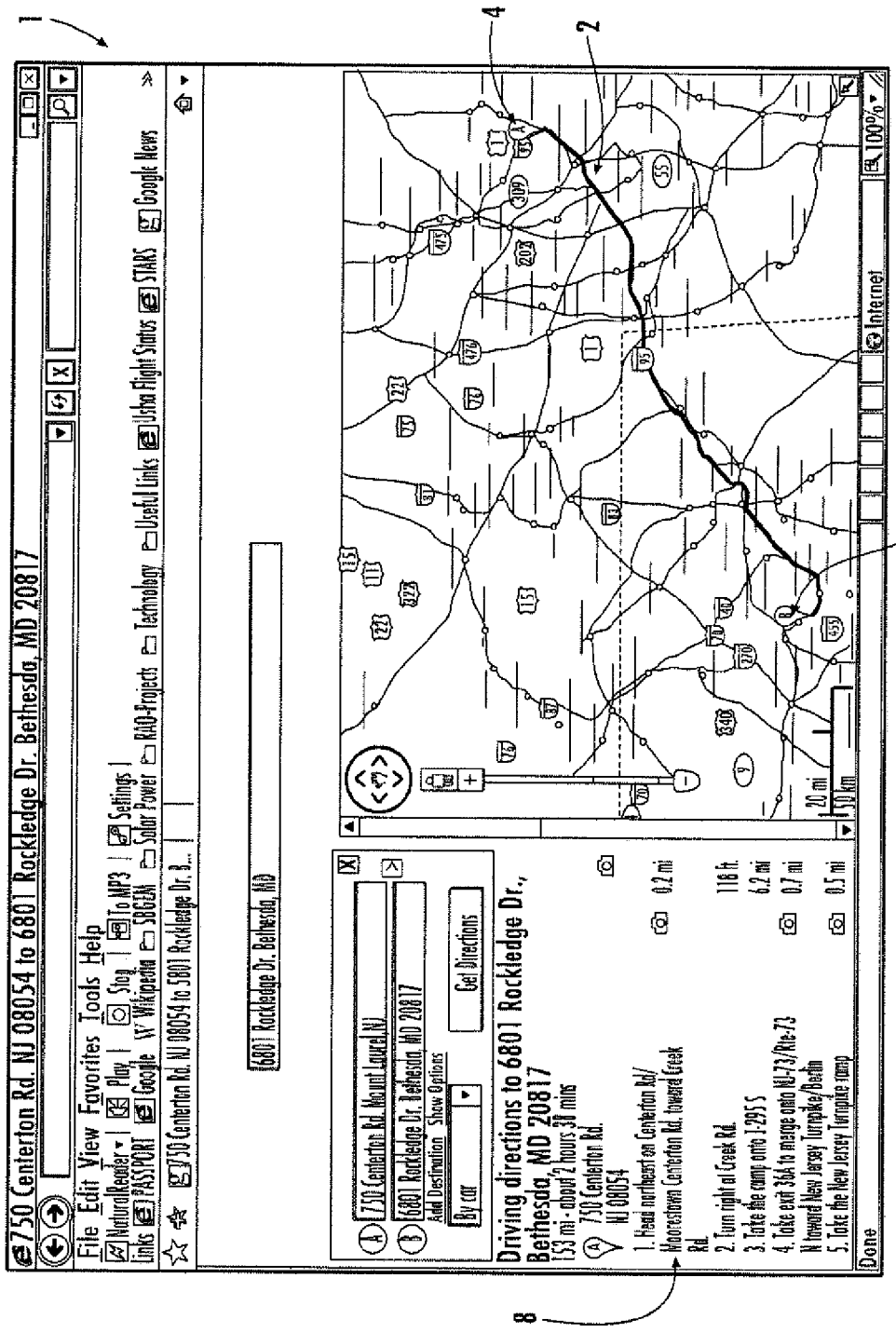

FIG. 1
Prior Art

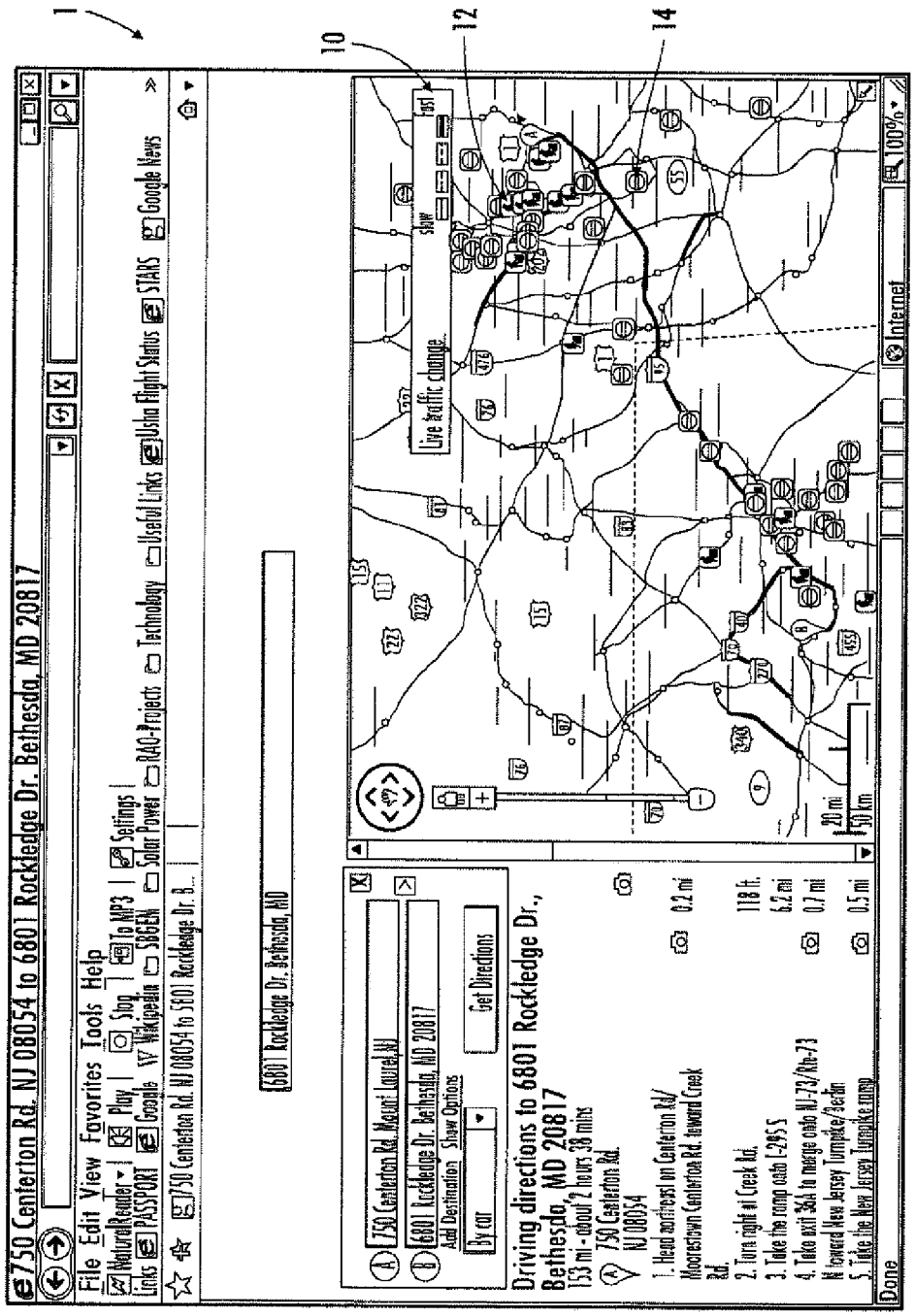

FIG. 2
Prior Art

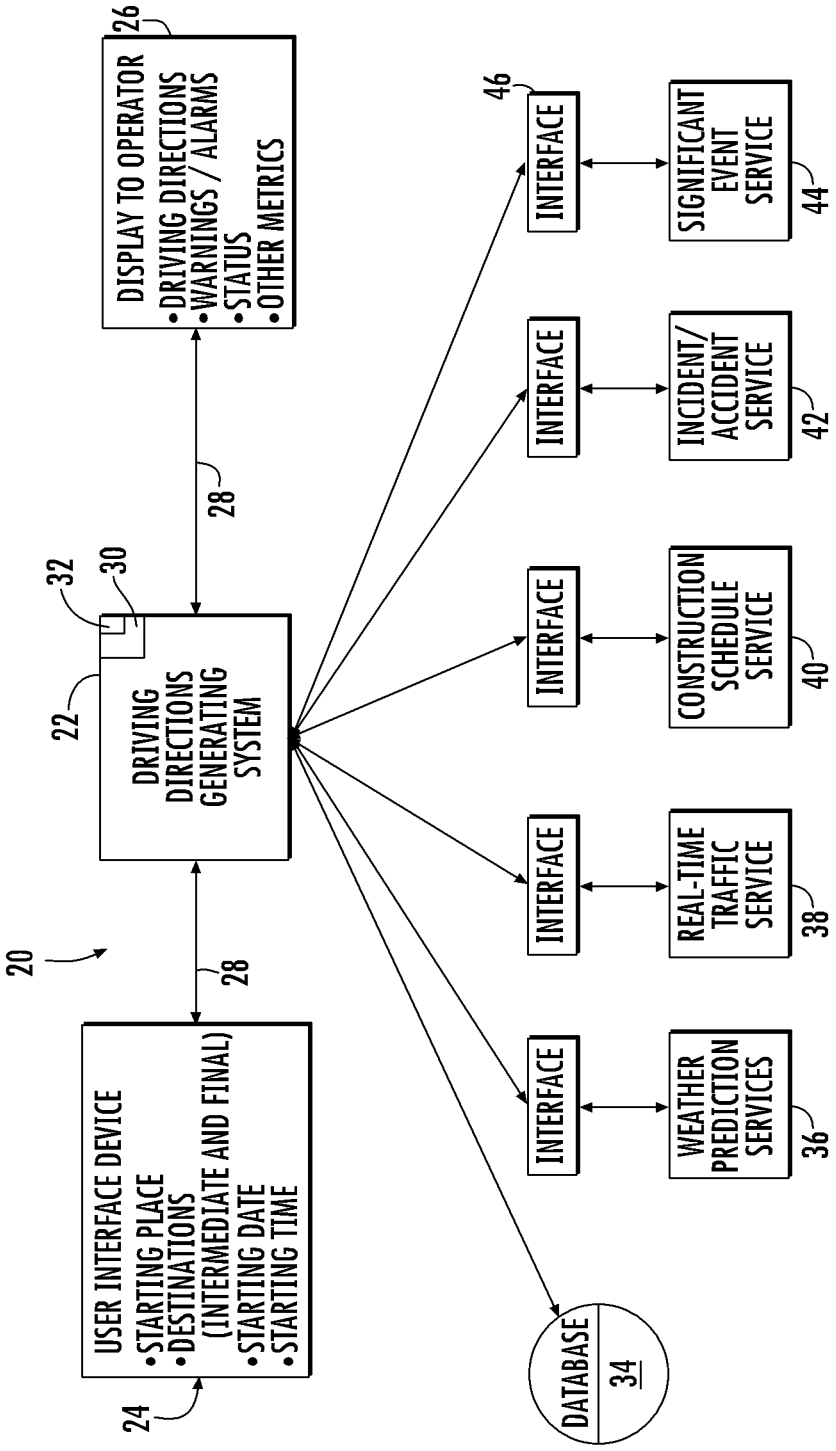
20
USER INTERFACE DEVICE
•STARTING PLACE
•DESTINATIONS (INTERMEDIATE AND FINAL)
•STARTING DATE
•STARTING TIME
24
28
DRIVING DIRECTIONS GENERATING SYSTEM
22
32
30
28
DISPLAY TO OPERATOR
•DRIVING DIRECTIONS
•WARNINGS / ALARMS
•STATUS
•OTHER METRICS
26
DATABASE
34
INTERFACE
WEATHER PREDICTION SERVICES
36
INTERFACE
REAL-TIME TRAFFIC SERVICE
38
INTERFACE
CONSTRUCTION SCHEDULE SERVICE
40
INTERFACE
INCIDENT/ ACCIDENT SERVICE
42
INTERFACE
SIGNIFICANT EVENT SERVICE
44
46

FIG. 3

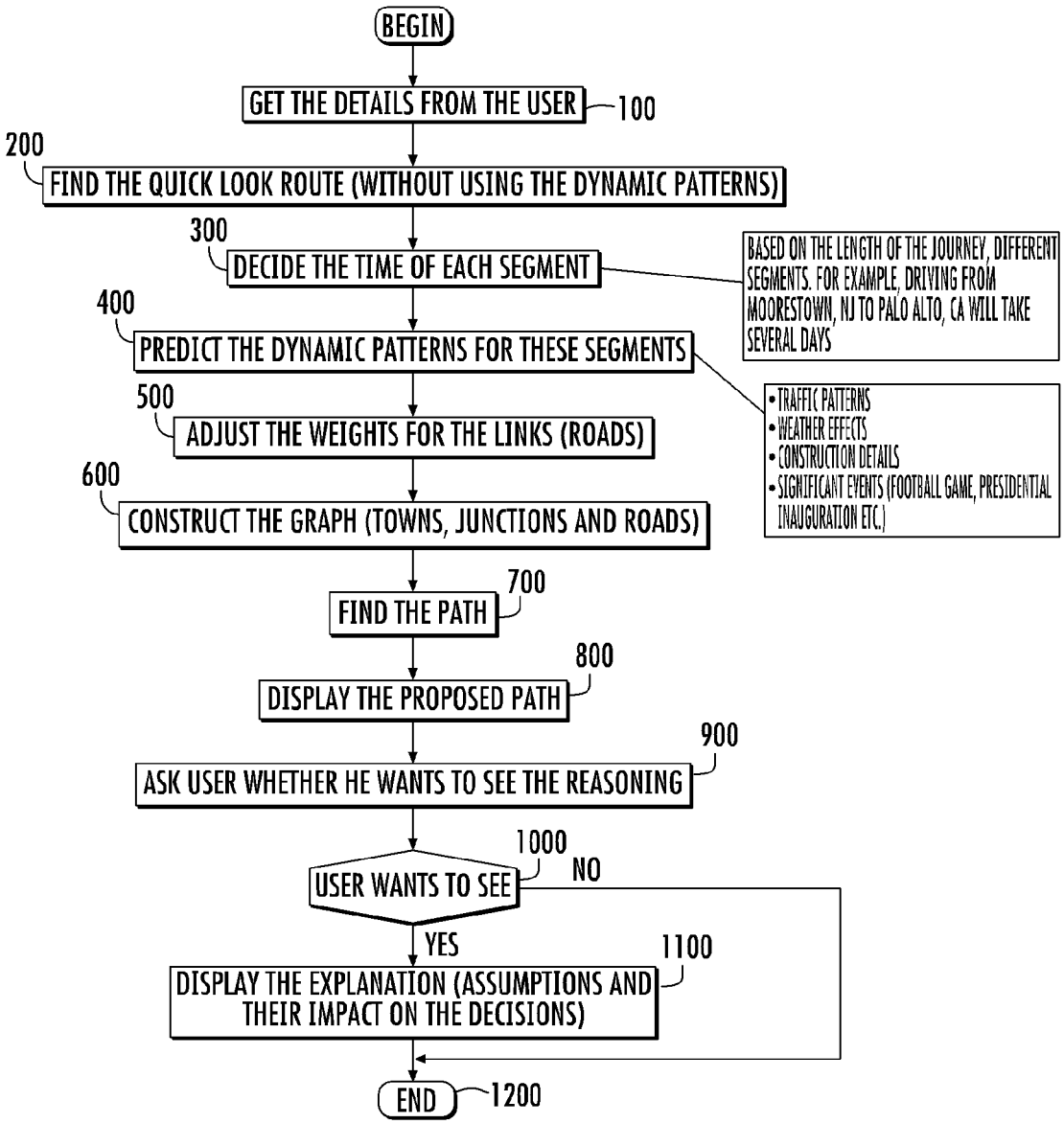
BEGIN
GET THE DETAILS FROM THE USER
100
200
FIND THE QUICK LOOK ROUTE (WITHOUT USING THE DYNAMIC PATTERNS)
300
DECIDE THE TIME OF EACH SEGMENT
BASED ON THE LENGTH OF THE JOURNEY, DIFFERENT SEGMENTS. FOR EXAMPLE, DRIVING FROM MOORESTOWN, NJ TO PALO ALTO, CA WILL TAKE SEVERAL DAYS
400
PREDICT THE DYNAMIC PATTERNS FOR THESE SEGMENTS
• TRAFFIC PATTERNS
• WEATHER EFFECTS
• CONSTRUCTION DETAILS
• SIGNIFICANT EVENTS (FOOTBALL GAME, PRESIDENTIAL INAUGURATION ETC.)
500
ADJUST THE WEIGHTS FOR THE LINKS (ROADS)
600
CONSTRUCT THE GRAPH (TOWNS, JUNCTIONS AND ROADS)
700
FIND THE PATH
800
DISPLAY THE PROPOSED PATH
900
ASK USER WHETHER HE WANTS TO SEE THE REASONING
1000
USER WANTS TO SEE
NO
YES
1100
DISPLAY THE EXPLANATION (ASSUMPTIONS AND THEIR IMPACT ON THE DECISIONS)
END
1200

FIG. 4

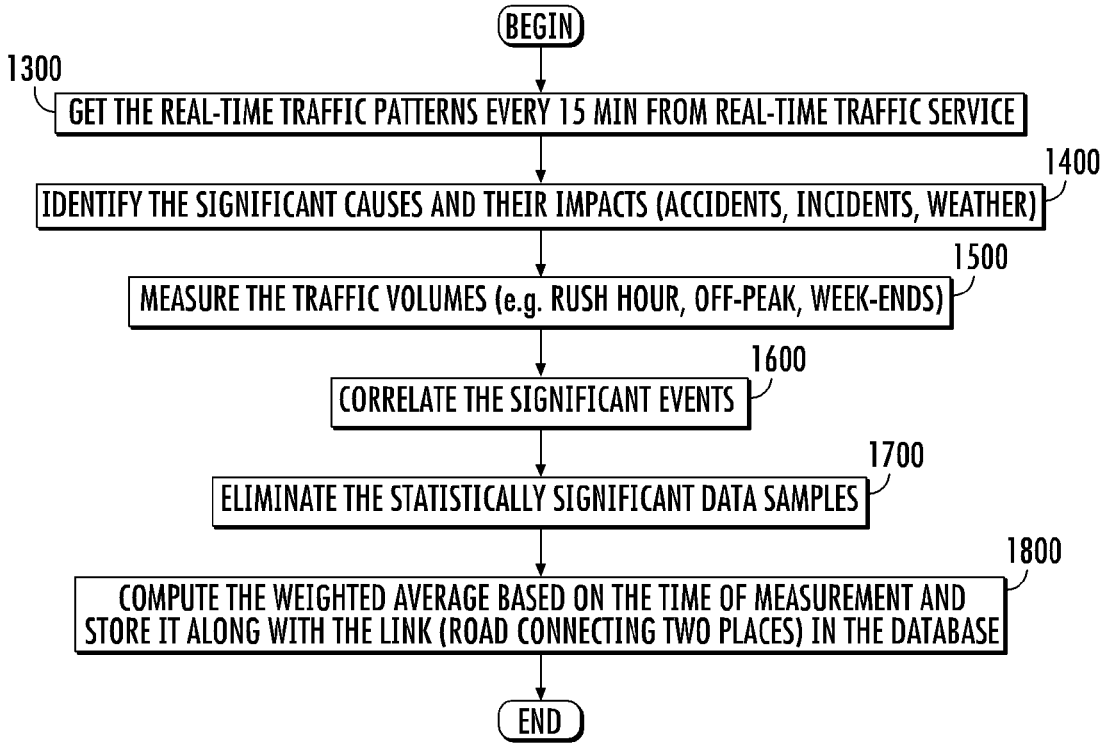
BEGIN
1300
GET THE REAL-TIME TRAFFIC PATTERNS EVERY 15 MIN FROM REAL-TIME TRAFFIC SERVICE
1400
IDENTIFY THE SIGNIFICANT CAUSES AND THEIR IMPACTS (ACCIDENTS, INCIDENTS, WEATHER)
1500
MEASURE THE TRAFFIC VOLUMES (e.g. RUSH HOUR, OFF-PEAK, WEEK-ENDS)
1600
CORRELATE THE SIGNIFICANT EVENTS
1700
ELIMINATE THE STATISTICALLY SIGNIFICANT DATA SAMPLES
1800
COMPUTE THE WEIGHTED AVERAGE BASED ON THE TIME OF MEASUREMENT AND STORE IT ALONG WITH THE LINK (ROAD CONNECTING TWO PLACES) IN THE DATABASE
END

FIG. 5

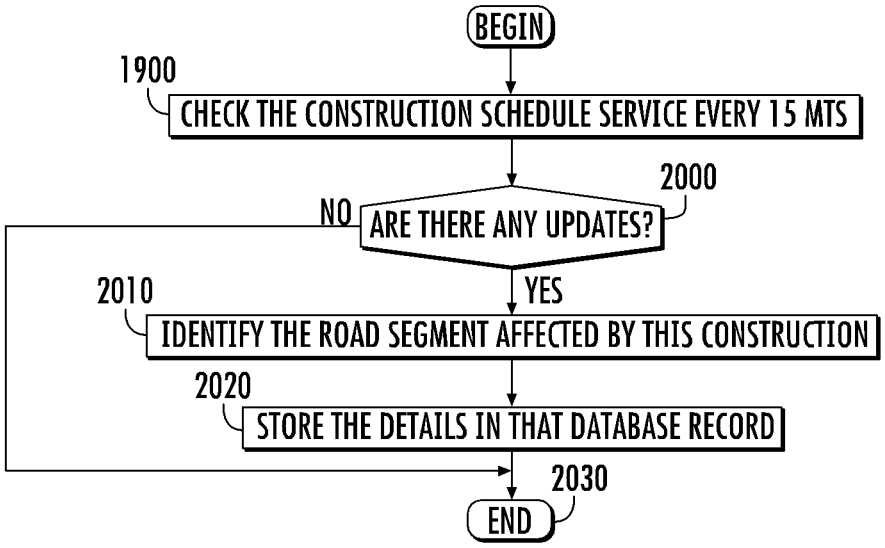
BEGIN
1900
CHECK THE CONSTRUCTION SCHEDULE SERVICE EVERY 15 MTS
2000
NO
ARE THERE ANY UPDATES?
YES
2010
IDENTIFY THE ROAD SEGMENT AFFECTED BY THIS CONSTRUCTION
2020
STORE THE DETAILS IN THAT DATABASE RECORD
2030
END

FIG. 6

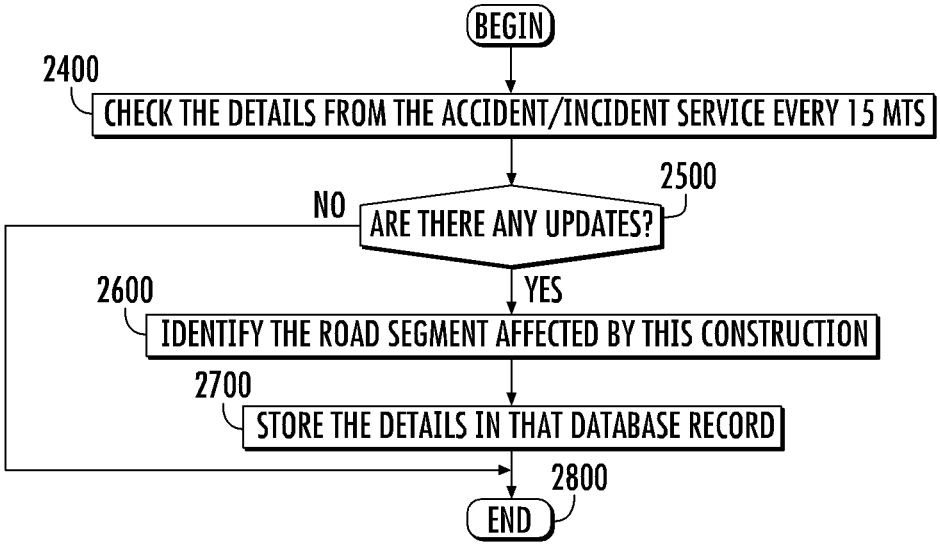
BEGIN
2400
CHECK THE DETAILS FROM THE ACCIDENT/INCIDENT SERVICE EVERY 15 MTS
2500
NO
ARE THERE ANY UPDATES?
YES
2600
IDENTIFY THE ROAD SEGMENT AFFECTED BY THIS CONSTRUCTION
2700
STORE THE DETAILS IN THAT DATABASE RECORD
2800
END

FIG. 7

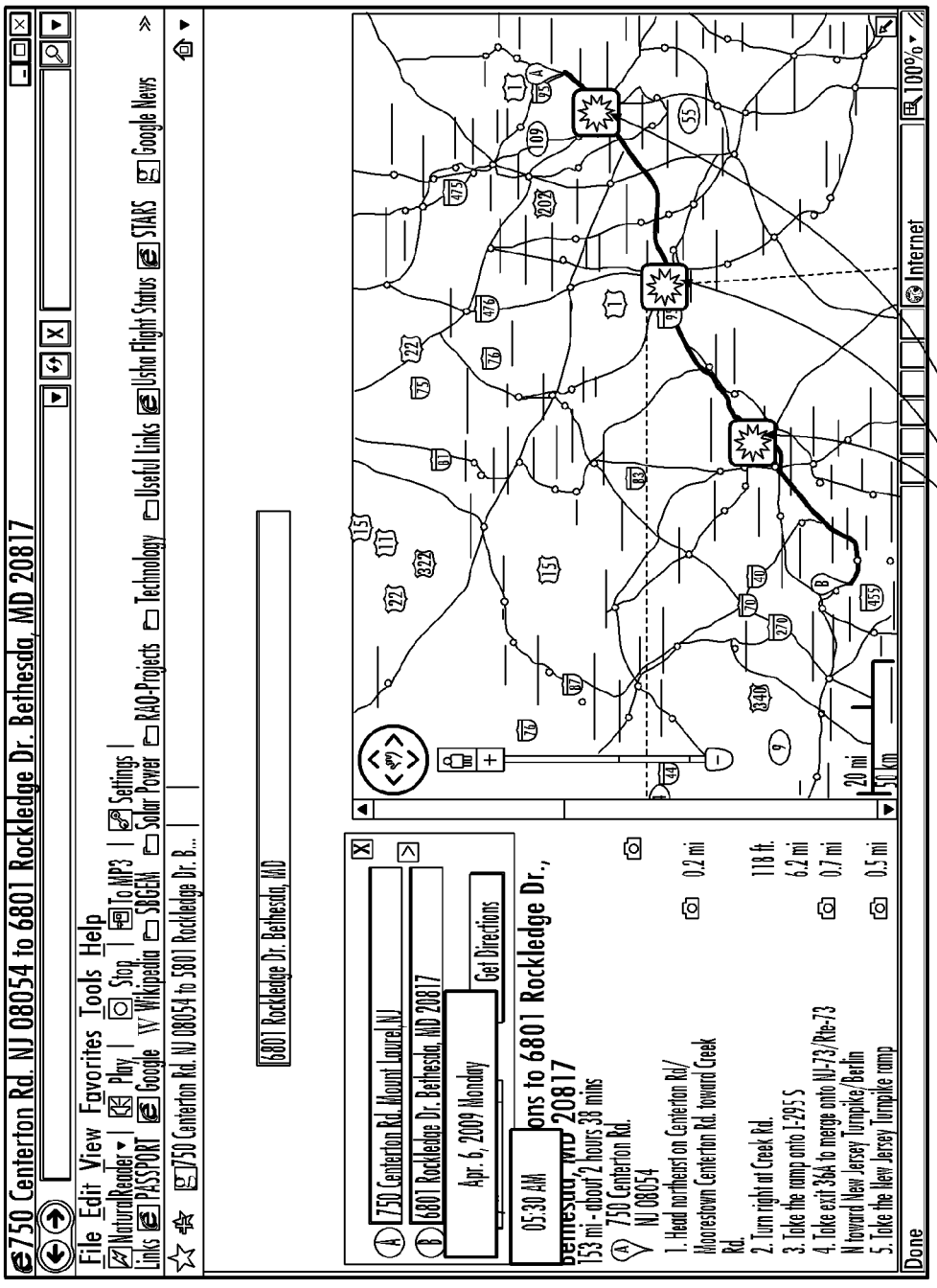
1
750 Centerton Rd. NJ 08054 to 6801 Rockledge Dr. Bethesda, MD 20817
File Edit View Favorites Tools Help
Links NaturalReader Play Stop to MP3 Settings
PASSPORT boogle Wikipedia SBGEM Solar Power RAO-Projects Technology Useful Links Usha Flight Status STARS Google News
750 Centerton Rd. NJ 08054 to 6801 Rockledge Dr. B...
6801 Rockledge Dr. Bethesda, MD
750 Centerton Rd. Mount Laurel, NJ
6801 Rockledge Dr. Bethesda, MD 20817
Apr. 6, 2009 Monday
Get Directions
05:30 AM
ons to 6801 Rockledge Dr.,
20817
153 mi - about 2 hours 38 mins
750 Centerton Rd.
NJ 08054
1. Head northeast on Centerton Rd/ Moorestown Centerton Rd. toward Creek Rd. 0.2 mi
2. Turn right at Creek Rd. 118 ft.
3. Take the ramp onto I-295 S 6.2 mi
4. Take exit 36A to merge onto NJ-73/Rte-73 N toward New Jersey Turnpike/Berlin 0.7 mi
5. Take the New Jersey Turnpike ramp 0.5 mi
20 mi
50 Km
Done
Internet
100%
48

FIG. 8

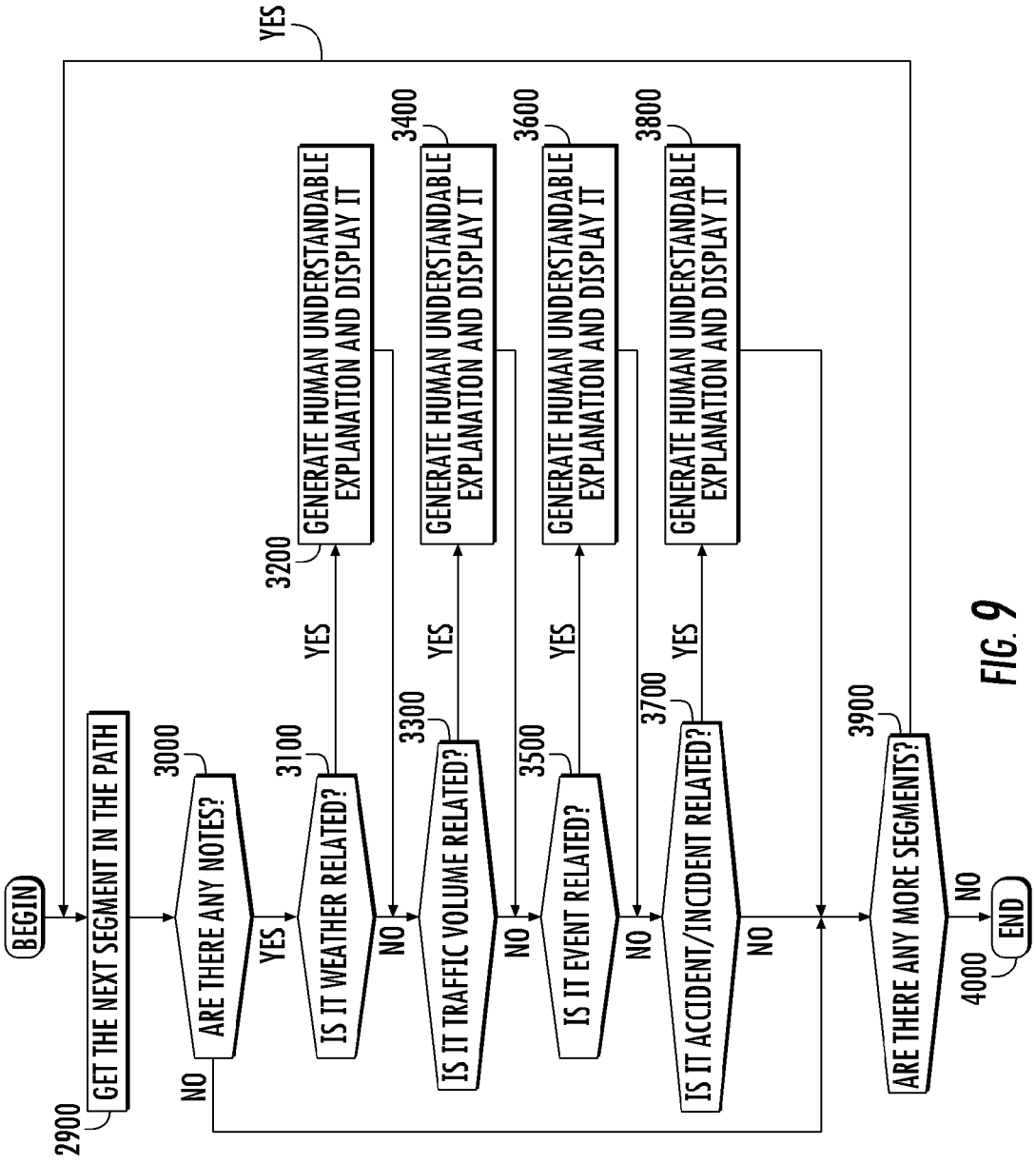
BEGIN
2900
GET THE NEXT SEGMENT IN THE PATH
3000
ARE THERE ANY NOTES?
NO
YES
3100
IS IT WEATHER RELATED?
YES
3200
GENERATE HUMAN UNDERSTANDABLE EXPLANATION AND DISPLAY IT
NO
3300
IS IT TRAFFIC VOLUME RELATED?
YES
3400
GENERATE HUMAN UNDERSTANDABLE EXPLANATION AND DISPLAY IT
NO
3500
IS IT EVENT RELATED?
YES
3600
GENERATE HUMAN UNDERSTANDABLE EXPLANATION AND DISPLAY IT
NO
3700
IS IT ACCIDENT/INCIDENT RELATED?
YES
3800
GENERATE HUMAN UNDERSTANDABLE EXPLANATION AND DISPLAY IT
NO
3900
ARE THERE ANY MORE SEGMENTS?
YES
NO
4000
END

FIG. 9

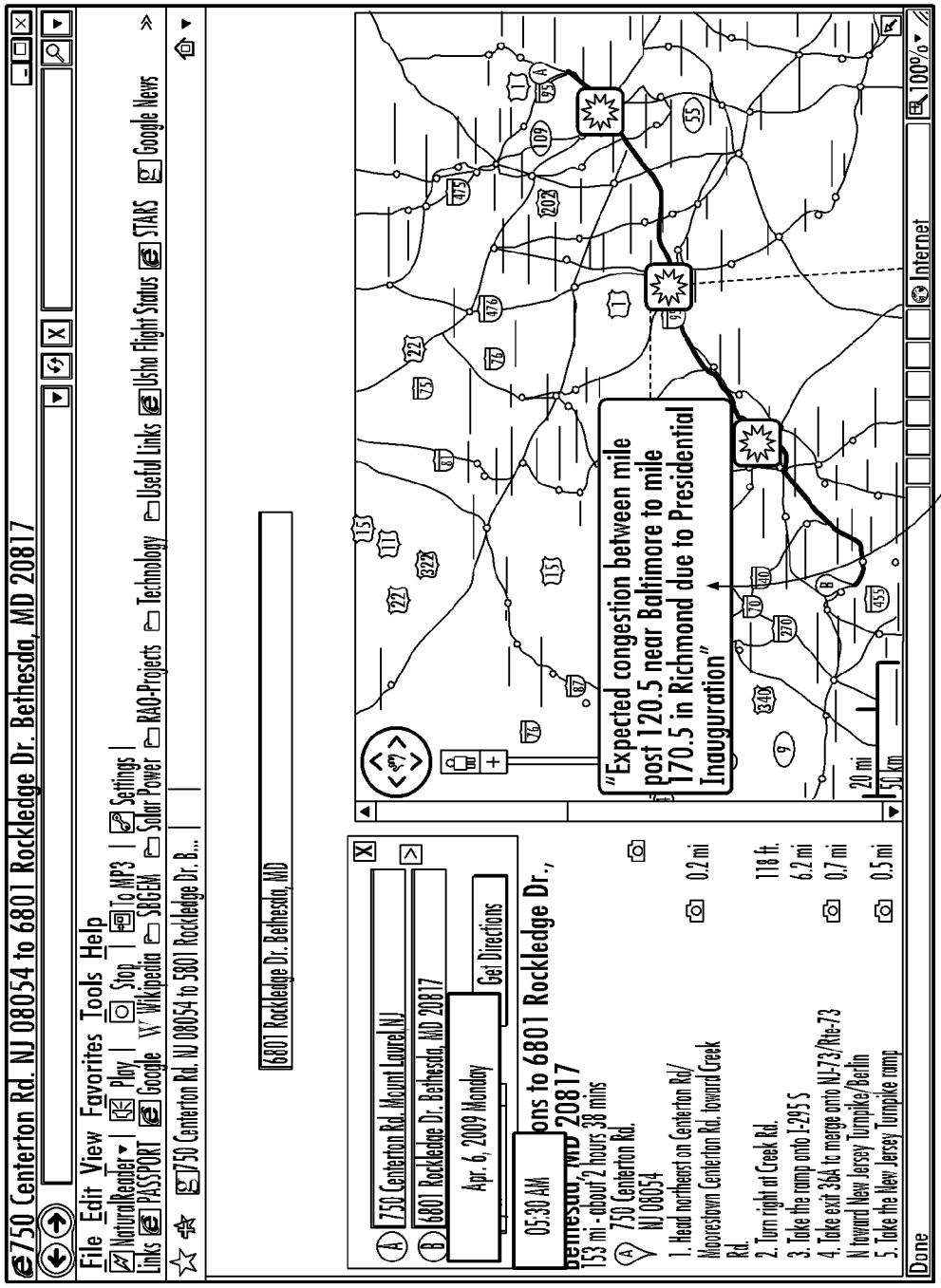
750 Centerton Rd. NJ 08054 to 6801 Rockledge Dr. Bethesda, MD 20817
File Edit View Favorites Tools Help
Settings
To MP3
Stop
Play
NaturalReader
Links
PASSPORT
Google
Wikipedia
SBCEM
Solar Power
RAO-Projects
Technology
Useful Links
Ushu Flight Status
STARS
Google News
750 Centerton Rd. NJ 08054 to 6801 Rockledge Dr. B...
6801 Rockledge Dr. Bethesda, MD
750 Centerton Rd. Mount Laurel, NJ
6801 Rockledge Dr. Bethesda, MD 20817
Get Directions
Apr. 6, 2009 Monday
05:30 AM
ons to 6801 Rockledge Dr.,
20817
153 mi - about 2 hours 38 mins
750 Centerton Rd.
NJ 08054
1. Head northeast on Centerton Rd/ Moorestown Centerton Rd. toward Creek Rd. 0.2 mi
2. Turn right at Creek Rd. 118 ft.
3. Take the ramp onto I-295 S 6.2 mi
4. Take exit 36A to merge onto NJ-73/Rte-73 N toward New Jersey Turnpike/Berlin 0.7 mi
5. Take the New Jersey Turnpike ramp 0.5 mi
"Expected congestion between mile post 120.5 near Baltimore to mile 170.5 in Richmond due to Presidential Inauguration"
20 mi
50 Km
Done
Internet
100%
50

FIG. 10

SYSTEM AND METHOD FOR REAL TIME OPTIMIZATION OF DRIVING DIRECTIONS

FIELD OF THE INVENTION

The invention relates to generating driving directions using computer algorithms. More specifically, the invention relates to computer-generated driving directions that minimize the impact of weather, traffic conditions, road closures, construction and the like, on travel efficiency.

BACKGROUND OF THE INVENTION

Travelers often take a variety of approaches to navigate between a trip's origin and destination. Either as a supplement for a map or as a replacement, a person who is familiar with a route often composes driving instructions from memory and communicates them to a driver. The driver uses a written copy of the instructions as a guide to following the route. While the human based approach to navigation has benefits, it has significant limitations. In many cases, a driver simply cannot access anyone with familiarity of a route or a particular destination. And while human based driving instructions are usually the easiest to follow by a driver, frequently humans can remember or describe routes inaccurately. Human-generated instructions can be susceptible to human error. And, since individual perception is subjective, the quality and consistency of human-generated instructions can vary greatly.

As an alternative to the human based driving directions or instructions, computers can routinely generate driving instructions via conventional technologies. Commercial sources, including Internet websites and stand-alone software packages, offer a driver a list of instructions, or a driving itinerary, between one location and another. Conventional computer-generated driving instructions are generally more consistent than human-generated instructions. And with the recent proliferation of mobile computing and Internet technologies, computer-generated driving instructions are reasonably accessible in many driving situations.

Referring now to FIG. **1**, an exemplary computer-generated map **1** is shown, including a proposed highlighted route **2** between two geographic points **4**, **6**. A set of textual, turn-by-turn, directions **8** is provided adjacent to, or overlying, a portion of the map that provide instruction to a driver about the individual turns required to navigate the highlighted route **2**. FIG. **2** shows the map **1** of FIG. **1** with additional graphical information indicating regions of relative traffic slowness due to general congestion (as indicated by color key **10**), construction zones **12**, and road closures and detours **14**, all of which may impact driving times. Maps and driving directions of this type can be created using well-known software such as Google™ maps, Yahoo!® LOCAL Maps, MapQuest®, and the like.

Computers conventionally derive these driving directions from commercially available databases that contain the geographic location of roads and intersections in a region. Conventional mapping software generates a route between user-selected start and destination points by processing the commercial database. The software typically displays a route by highlighting it on a traditional map and displaying the highlighted map through a user interface. To accompany the map, conventional software can generate textual driving instructions with what can be referred to as an itinerary module.

While conventional mapping systems are easily accessible and generally produce acceptable directions, such systems

may not consider current conditions (i.e., conditions existing at the time of the trip) that can substantially impact the amount of time it will take to traverse the presented route. Rather, existing systems are often used to obtain directions for use at some point in the future (e.g., directions obtained on Friday afternoon for a trip beginning the following Monday morning). In addition, existing systems use static routing, which does not take dynamic conditions (e.g., traffic delays due to volume, weather conditions such as snow, sleet, rain, construction delays, and the like) into consideration. More often than not, the real travel time is very different from the duration estimated by these conventional systems. Indeed, many conventional systems include a disclaimer along with their directions, indicated that construction projects, traffic, weather or other events may cause conditions to differ from the mapped results.

As noted, ever changing factors such as bad weather, accidents, lane closures, general construction, rush hour, and the like can substantially affect the time required for the user to travel from point to point along the route. If such factors were considered, the total trip time could be reduced simply by making changes to (i.e., avoiding) the affected portions of the route.

It would, therefore, be desirable to provide a system that considered a plethora of real-time factors to calculate the most efficient route for a user to follow. It would also be desirable to provide a system that informs the user of the rationale for presenting a particular route, so that the user can further customize the route based on personal preferences.

SUMMARY OF THE INVENTION

A method for providing driving directions for a trip, comprising: obtaining a start point for a trip; obtaining an end point for the trip; obtaining a start time and a start date for the trip; obtaining and storing traffic volume information in a database; obtaining and storing information representing potential causes of delay in said database; constructing a graph of a plurality of potential routes linking the start point to the end point, wherein the graph comprises a plurality of nodes and a plurality of links connecting the nodes; assigning a weight to each of said plurality of links based on the stored traffic volume information and the stored potential causes of delay; applying a shortest path algorithm to obtain a proposed route of said plurality of potential routes; and displaying the proposed route to the user on a display.

A system for providing driving directions for a trip, comprising a processing unit connected to and in communication with a database and a display, and a machine-readable storage medium encoded with a computer program code such that, when the computer program code is executed by a processor, the processor performs a method comprising: obtaining a start point for a trip; obtaining an end point for the trip; obtaining a start time and a start date for the trip; obtaining and storing traffic volume information in a database; obtaining and storing information representing potential causes of delay in said database; constructing a graph of a plurality of potential routes linking the start point to the end point, wherein the graph comprises a plurality of nodes and a plurality of links connecting the nodes; assigning a weight to each of said plurality of links based on the stored traffic volume information and the stored potential causes of delay; applying a shortest path algorithm to obtain a proposed route of said plurality of potential routes; and displaying the proposed route to the user via the display.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features and advantages of the present invention will be more fully disclosed in, or rendered obvious

by, the following detailed description of the preferred embodiment of the invention, which is to be considered together with the accompanying drawings wherein like numbers refer to like parts, and further wherein:

FIG. **1** is an exemplary map including a proposed highlighted travel route between two geographic points;

FIG. **2** shows the map of FIG. **1** incorporating graphical features to indicate regions of congestion, construction and road closures.

FIG. **3** is a diagram of the disclosed system;

FIG. **4** is flow chart of a method for generating driving directions;

FIG. **5** is a flow chart of a method for maintaining a database of traffic details for use with the method of FIG. **4**;

FIG. **6** is a flow chart of a method for maintaining a database of construction details for use with the method of FIG. **4**;

FIG. **7** is a flow chart of a method for maintaining a database of accidents and incidents details for use with the method of FIG. **4**;

FIG. **8** is an exemplary screen shot of a map and route generated by the disclosed system and method of FIGS. **3** and **4**;

FIG. **9** is a flow chart of a method for producing a rationale behind a particular route generated using the method of FIG. **3**; and

FIG. **10** is an exemplary informational window for use with the disclosed system and method of FIGS. **3** and **4**.

DETAILED DESCRIPTION

A system and method are disclosed for enhancing computer calculated driving directions by incorporating dynamic predictive traffic patterns during the computation. The disclosed system and method enable a user to realistically plan for a trip by taking a number of dynamic factors into account in calculating a proposed route. Examples of such dynamic factors include dynamic traffic patterns, weather related delays, construction delays, as well as the number (and time-of-day characteristics of) intervening traffic control devices. The accuracy and usefulness of the resulting directions will be substantially improved over those obtained using static information.

In addition to providing a proposed set of driving directions, the system and method can provide the user with an explanation of how the directions were calculated. For example, the system can identify to the user that a particular route has been selected due to a traffic accident identified on another, perhaps shorter, route. Providing this level of detail to the user will result in increased user confidence in the system.

Thus, in addition to the accepting the start and end points of a user's proposed trip, the system and method can include additional input points, which can include the start date and start time for the trip. Using this information, the system uses a set of predicted conditions to calculate a proposed trip route. A non-limiting example of such predicted conditions may include traffic patterns, weather effects, and construction delays associated with each of a plurality of possible routes. These conditions may be used to adjust "weights" associated with each leg in the trip to result in a proposed route to obtain the shortest predicted travel time, or the shortest travel distance.

The proposed route can then be displayed in a graphical form, along with a presentation of the assumptions used in calculating the path (e.g., traffic, accidents, inclement weather) and their impact on the trip time. A separate window may be provided to display this rationale to the user, or the information can be displayed in a window overlying a portion of the graphical route display.

Referring to FIG. **3**, the disclosed system **20** may comprise a driving directions generating system **22** in communication with a user interface device **24** and an operator display device **26**. Communications links **28** between the driving directions generating system **26** and the interface and display devices **24**, **26** may be hard wired or wireless connection types. A non-limiting list of exemplary technologies making up the communication link includes analog or digital phone lines, fiber optic lines, T1 or T2 lines, public/private networks, wireless (Radio Frequency (RF)), cellular and/or satellite connections. In addition, a portion of the communication link **28** may be a public or private network (e.g., the Internet).

The user interface device **24** may comprise any of a variety of devices that enable a user to input information such as starting place, intermediate and final destination(s), starting date and starting time, into the driving directions generating system. A non-limiting list of exemplary devices include desktop computers, laptop computers, personal digital assistants (PDAs), and cell phones, and the like. In addition to obtaining input information directly from the user interface device **24**, the system may take input directly from the database **34**. An example of this is where the user has selected and saved route details in the database for future use. In such case, the database **34** can be an input and/or output device.

The operator display device **26** may be any of a variety of output or display devices, such as printers or graphical display devices (e.g., computer screens, cell phone screen, PDA screen), suitable for displaying the calculated driving directions, warnings/alarms, status, or other metrics to the user. As previously noted, the database **34** can be used as an output device, where a user selects and saves routing details for future use.

The driving directions generating system **22** may comprise a processor **30** with a local or remote memory **32**. The system **22** may be configured to receive information from a variety of sources that can be used to build and update a database **34** of information that can be used by the system **22** to develop a set of driving directions. The sources from which the system **22** may receive such information include a weather prediction service **36**, a real-time traffic information service **38**, a construction schedule service **40**, an incident/accident service **42**, and a significant event service **44**. The directions generating system **22** may be connected to one or more of these services via an appropriate interface **46**. Examples of such interfaces include hard wired or wireless public or private networks (e.g., the Internet).

The weather prediction service **36** may provide the system **22** with information relating to predicted weather patterns that may affect travel times along segments of a selected route. Thus, if the user's travel plans include a route that traverses a geographic area for which heavy weather (e.g., rain, snow) is predicted for the time period during which the user will be travelling that route, such information is provided to the system for use in determining the recommended route. In one exemplary embodiment, the weather prediction service **36** is a Really Simple Syndication (RSS) feed from the Weather Channel.

The real-time traffic service **38** may provide the system **22** with information relating to traffic volumes (e.g., rush hour, off-peak, weekend) associated with each portion of a potential route at particular times of day. The construction schedule service **40**, may provide the system **22** with information relating to on-going and scheduled construction events associated with each portion of a potential route, again, tied to the time

during the day/night at which the construction is scheduled to occur. In one exemplary embodiment, the real-time traffic service **38** is an RSS feed from NAVTEQTraffic.com.

The incident/accident service **42** may provide information relating to immediate incidents (e.g., road block, traffic stop) or accidents associated with each portion of a potential route. The significant event service **44** may provide the system **22** with information regarding scheduled events (e.g., presidential inauguration, football game) that can impact the travel time along portions of a potential route. In one exemplary embodiment, the real-time incident/accident service **42** is SmartTraveler.com.

In general, the driving directions generating system **22** may obtain information from one or more of these services, and may use that information to generate and/or update information contained in the database **34**. Updates to the database **34** may be periodic, or they may be based on other criteria. In one embodiment, the database is updated using information from one or more of the services every 15 minutes). The timing of updates is not critical, and thus the system **22** can obtain updates as frequently as needed in order to obtain a desired level of accuracy. In one embodiment the system **22** updates the database based on a standard deviation analysis. In another embodiment, the system uses Chauvenet's criterion and/or Pierce's criterion to eliminate statistically significant data samples from the database.

Maintaining the database with current information enables more accurate driving directions to be provided to the user. Thus, whenever a user requests the system **22** to provide driving directions, the system can utilize the most current data available to it in calculating a recommended driving route.

Referring to FIG. **4**, the method may begin at step **100**, where the user inputs travel information from the user interface device **24**. This travel information should include at least the trip start and end points, and the trip start date and start time of day. At step **200**, the system obtains a "Quick Look Route" obtained without using any of the dynamic pattern information contained in the database **34**. This "Quick Look Route" may be obtained using a technique such as that described in U.S. Pat. No. 7,372,816 to Mannepalli, et al., and U.S. Pat. No. 6,842,425 to Mannepalli et al., the entirety of which patents are incorporated herein by reference.

At step **300**, the route is divided into a plurality of segments, and a time for each segment is determined. Based on the length of the journey, each segment of a route may be subject to traffic patterns, etc. that occur at different times of day. For example, driving from New Jersey to California will take several days, and thus, each segment of the route will be encountered by the user at a different time of day and/or different day of the week.

At step **400**, the dynamic patterns are predicted for each of the plurality of segments identified in step **300**. These dynamic patterns will include traffic patterns (volume), weather effects, construction details, and significant events data, as previously described.

At step **500**, weights are assigned to each of the plurality of segments identified in step **300**. The weights are assigned to each of the segments based on the dynamic pattern information (obtained from the database **34**) that relates to each segment. At step **600**, a graph of a suggested route is constructed. The graph includes towns, junctions, and roads that are part of the suggested route.

At step **700**, the system finds the path by dividing the route into a plurality of nodes (i.e., junctions) and links (i.e., road segments), and apply a well known shortest path algorithm such as Dijkstra's algorithm. At step **800**, the suggested route is displayed to the user via the operator display device **26**. At step **900** the system **22** sends an inquiry to the user asking if the user would like to be provided with an explanation of the rationale of why the particular route is suggested. At step **1000**, if the user elects to display the rationale, then at step **1100** an explanation is displayed, including a listing and/or description of the underlying assumptions and their impact on routing decisions. If the user elects not to display the rationale, then the method ends at step **1200**, and the user can save the suggested route and/or print the route for use.

Referring to FIG. **5**, a method for maintaining/updating the database **34** with recent traffic volume information is shown. At step **1300**, the system **22** obtains real-time traffic patterns from the real-time traffic service **38**. At step **1400**, significant causes of delay (e.g., accidents, incidents, weather) are identified, along with their associated relative impacts. At step **1500**, traffic volumes are measured (e.g., rush hour, off peak, weekends). At step **1600**, significant events (e.g., football game, presidential inauguration) are correlated to determine whether the delay should be used to update the database **34**. In one exemplary embodiment of this correlation step, the real time traffic service **38** may indicate that a stretch of I-76 between Mile 351 and Mile 340 will be seriously affected (e.g., delays of 30 minutes), that a stretch of I-295 between mile 25.0 and mile 30.0 will be moderately affected (e.g., delays of up to 10 minutes), and that a stretch of route R-42 between mile 15.0 and mile 12.0 will be moderately affected (e.g., delays of up to 15 minutes), and that the entire stretch of I-676 will be nominally affected (e.g., delays of less than 5.0 minutes). If these data points are within preselected statistical limits, then the data is stored in the database **34** and the driving times for those sections of roadway are updated. If these data points are not within the preselected statistical limits (i.e., they are determined to be outliers), then a root cause analysis is performed to determine the approximate epicenter of the event causing the delay. In the illustrated case, the Ben Franklin Bridge is determined to be the epicenter. Thus, the system **22** determines whether there are any accidents or incidents (e.g., construction or special events) that could be contributing to the specific delays. For example, there may be no accidents or incidents, but there may be a baseball game. In such a case, the driving times for the specific sections of roadway would not be updated in the database **34**. The data would, however, be stored in the database **34** to compute predicted travel times in the future where travel will occur at the same time as a similar event (in this case, a baseball game). At step **1700**, statistically significant data samples are eliminated using, for example Chauvenet's criterion, Pierce's criterion, or other appropriate technique. At step **1800**, weighted averages of each link/segment are computed based on the time of measurement. For example, if **200** measurements exist in the database **34** relating to a particular route segment, and each has been provided to the system **22** by the a particular service on different days of the year, the more recent measurements will be given a higher weight than the older data. The weighted averages are stored, along with the link/segment, in the database **34**.

Referring to FIG. **6**, a method for maintaining/updating the database **34** with recent construction information is shown. At step **1900**, the system **22** queries the construction schedule service **40**. At step **2000**, the system **22** determines if there are any updates to the construction information. If there are updates, then at step **2010**, the road segment affected by the update is identified. At step **2020**, the details regarding the construction update are associated with the road segment and stored in the database **34**, and the method ends at step **2030**. If no updates exist, then the method proceeds directly from step **2000** to step **2030**.

Referring to FIG. **7**, a method for maintaining/updating the database **34** with recent accident/incident information is shown. At step **2400**, the system **22** queries the incident/accident service **42**. At step **2500**, the system **22** determines if there are any updates to the incident/accident information. If there are updates, then at step **2600**, the road segment affected by the update is identified. At step **2700**, the details regarding the incident/accident update are associated with the road segment and stored in the database **34**, and the method ends at step **2800**. If no updates exist, then the method proceeds directly from step **2500** to step **2800**.

In the illustrated embodiment, the steps of FIGS. **5-7** are repeated every 15 minutes, though, as previously noted, other periodicity values may be used.

FIG. **8** shows a route calculated using the disclosed method. The route is shown overlying an exemplary map. If there are any notes of explanation for route deviations, the affected section can be flagged with a pushpin icon **48** or other appropriate indicator. The icon may be provided as a link that the user can click in order to obtain the underlying explanation for the deviation.

As previously noted, the system **22** can provide the user with information about why a particular route has been suggested. For example, if substantial construction delays are predicted for a particular segment of a route, the system **22** may have selected an alternative segment or set of segments that ultimately provide the user with the most time-efficient route. Apart from mere curiosity, it may be important for a user to acknowledge the underlying computational rationale for a particular route to engender in the user a level of confidence with the system **22**. FIG. **9** shows an exemplary method for generating a textual message that explains the rationale for selecting a particular route, and for displaying that message to the user via the operator display device **26**.

At step **2900**, a first segment in the suggested path is selected. At step **3000**, the system **22** determines whether there are any "notes" associated with that segment. The notes will be customized to the particular route, and will provide sufficient information to enable the user to understand the rationale for the selection of a particular routing scheme. Thus, an exemplary note may read "Expected congestion between mile post 120.5 near Baltimore to mile post 170.5 in Richmond due to Presidential Inauguration." If notes exist for the segment, at step **3100**, the system **22** determines if the note is weather related. If it is, then at step **3200**, a human understandable explanation is generated and displayed on the operator display device **26**. At step **3300**, the system **22** determines whether a note exists that is traffic volume related. If one does exist, then at step **3400**, a human understandable explanation is generated and displayed on the operator display device **26**. At step **3500**, the system **22** determines whether a note exists that is related to a "significant event". If one does exist, then at step **3600**, a human understandable explanation is generated and displayed on the operator display device **26**. At step **3700**, the system **22** determines whether a note exists that is accident/incident related. If one does exist, then at step **3400**, a human understandable explanation is generated and displayed on the operator display device **26**. At step **3900**, the system **22** determines if there are any more segments in the suggested route. If the answer is yes, then the system returns to step **3000** and determines whether any notes exist for that next segment. If there are, then it repeats steps **3100-3800** as noted above, and goes on to the next segment. When the system determines that there are no more segments or notes relating to the suggested route, the method ends at step **4000**.

FIG. **10** shows an informational window **50** that provides explanatory information, generated using the method of FIG. **9**, regarding the fundamental assumptions used to calculate an exemplary suggested route. For example this window may contain information regarding construction or traffic delays that resulted in a longer route section selection. In the embodiment illustrated in FIG. **10**, the informational window indicates that congestion between particular mile markers is due to the Presidential Inauguration.

The method described herein may be automated by, for example, tangibly embodying a program of instructions upon a computer readable storage media capable of being read by machine capable of executing the instructions. A general purpose computer is one example of such a machine. A non-limiting exemplary list of appropriate storage media well known in the art would include such devices as a readable or writeable CD, flash memory chips (e.g., thumb drives), various magnetic storage media, and the like.

The functions and process steps herein may be performed automatically or wholly or partially in response to user command. An activity (including a step) performed automatically is performed in response to executable instruction or device operation without user direct initiation of the activity.

The systems and processes of FIGS. **3-10** are not exclusive. Other systems, processes and menus may be derived in accordance with the principles of the invention to accomplish the same objectives. Although this invention has been described with reference to particular embodiments, it is to be understood that the embodiments and variations shown and described herein are for illustration purposes only. Modifications to the current design may be implemented by those skilled in the art, without departing from the scope of the invention. The processes and applications may, in alternative embodiments, be located on one or more (e.g., distributed) processing devices accessing a network linking the elements of FIG. **3**. Further, any of the functions and steps provided in FIGS. **4-7** and **9** may be implemented in hardware, software or a combination of both and may reside on one or more processing devices located at any location of a network linking the elements of FIG. **3** or another linked network, including the Internet.

The features of the method have been disclosed, and further variations will be apparent to persons skilled in the art. All such variations are considered to be within the scope of the appended claims. Reference should be made to the appended claims, rather than the foregoing specification, as indicating the true scope of the disclosed system and method.

What is claimed is:

1. A method for providing driving directions for a trip, comprising:

obtaining a start point for a trip;

obtaining an end point for the trip;

obtaining a start time and a start date for the trip;

obtaining traffic volume information and updating a database with the traffic volume information;

obtaining delay information representing potential causes of delay;

correlating the delay information with preselected statistical limits to determine whether the delay information should be used to update the database;

responsive to a positive determination, updating the database with the delay information;

constructing a graph of a plurality of potential routes linking the start point to the end point, wherein the graph comprises a plurality of nodes and a plurality of links connecting the nodes;

assigning a weight to each of said plurality of links based on the stored traffic volume information and the potential causes of delay;

applying a shortest path algorithm to obtain a proposed route of shortest duration from said plurality of potential routes, wherein the proposed route includes selected segments and wherein at least one of the selected segments includes a note relating to a predicted delay identified on an unselected alternative segment to the at least one selected segment, based on one or both of the stored traffic volume information and the stored potential causes of delay;

reviewing the selected segments of the proposed route and generating a text explanation for each of the selected segments that includes the note relating to the predicted delay identified on the unselected alternative segment to the selected segment;

displaying to the user on the display a map of the proposed route; and

displaying to the user, on the display of the map of the proposed route, for each of the selected segments having the note, the text explanation relating to the note, thereby providing the user a rationale for not selecting the unselected alternative segment instead of the selected segment.

2. The method of claim **1**, wherein the step of obtaining the delay information representing potential causes of delay further comprises obtaining construction delay information.

3. The method of claim **1**, where the step of obtaining the delay information representing potential causes of delay comprises using Chauvenet's criterion to eliminate statistically significant data samples.

4. The method of claim **1**, where the step of obtaining the delay information representing potential causes of delay comprises using Peirce's criterion to eliminate statistically significant data samples.

5. The method of claim **1**, wherein the step of assigning a weight to each of said plurality of links comprises assigning a weight dependent upon a time of day.

6. The method of claim **5**, wherein a first link of said plurality of links is assigned a first weight associated with the start time of the trip, and a second link of said plurality of links is assigned a second weight associated with a time of the trip that is later than said start time.

7. The method of claim **6**, wherein said second weight is associated with a date of the trip that is later than said start date.

8. The method of claim **1**, wherein the display is a display on a device outside of the vehicle, and further comprising:

displaying to the user on the display an election of whether to display reasoning corresponding to the proposed route; and

wherein displaying to the user the text explanation relating to the note is responsive to receiving an affirmative election to display the reasoning corresponding to the proposed route.

9. The method of claim **1**, wherein correlating the delay information with the preselected statistical limits to determine whether the delay information should be used to update the database comprises:

determining whether the potential causes of delay corresponding to the delay information are within the preselected statistical limits;

responsive to a determination that the potential causes of delay corresponding to the delay information are within the preselected statistical limits, updating the database with the delay information including updating driving times corresponding to the delay information;

responsive to a determination that the potential causes of delay corresponding to the delay information are not within the preselected statistical limits:

performing a root cause analysis; and

updating the database with the delay information based on the root cause analysis.

10. A system for providing driving directions for a trip, comprising a processing unit connected to and in communication with a database and a display, and a machine-readable storage medium encoded with a computer program code such that, when the computer program code is executed by a processor, the processor performs a method comprising:

obtaining a start point for a trip;

obtaining an end point for the trip;

obtaining a start time and a start date for the trip;

obtaining traffic volume information and updating a database with the traffic volume information;

obtaining delay information representing potential causes of delay;

correlating the delay information with preselected statistical limits to determine whether the delay information should be used to update the database;

responsive to a positive determination, updating the database with the delay information;

constructing a graph of a plurality of potential routes linking the start point to the end point, wherein the graph comprises a plurality of nodes and a plurality of links connecting the nodes;

assigning a weight to each of said plurality of links based on the stored traffic volume information and the potential causes of delay;

applying a shortest path algorithm to obtain a proposed route of shortest duration from said plurality of potential routes, wherein the proposed route includes selected segments and wherein at least one of the selected segments includes a note relating to a predicted delay identified, on an unselected alternative segment to the at least one selected segment, based on one or both of the stored traffic volume information and the stored potential causes of delay;

reviewing the selected segments of the proposed route and generating a text explanation for each of the selected segments that includes the note relating to the predicted delay identified on the unselected alternative segment to the selected segment;

displaying to the user on the display a map of the proposed route; and

displaying to the user, on the display of the map of the proposed route, for each of the selected segments having the note, the text explanation relating to the note, thereby providing the user a rationale for not selecting the unselected alternative segment instead of the selected segment.

11. The system of claim **10**, wherein the step of obtaining the delay information representing potential causes of delay further comprises obtaining and storing construction delay information.

12. The system of claim **10**, where the step of obtaining the delay information representing potential causes of delay comprises using Chauvenet's criterion to eliminate statistically significant data samples.

13. The system of claim **10**, where the step of obtaining the delay information representing potential causes of delay comprises using Peirce's criterion to eliminate statistically significant data samples.

14. The system of claim 10, wherein the step of assigning a weight to each of said plurality of links comprises assigning a weight dependent upon a time of day.

15. The system of claim 14, wherein a first link of said plurality of links is assigned a first weight associated with the start time of the trip, and a second link of said plurality of links is assigned a second weight associated with a time of the trip that is later than said start time.

16. The system of claim 15, wherein said second weight is associated with a date of the trip that is later than said start date.

17. The system of claim 10, wherein the display is a display on a device outside of the vehicle, wherein the machine-readable storage medium encoded with the computer program code further includes computer program code which, when executed by a processor, causes the processor to perform the steps of:

displaying to the user on the display an election of whether to display reasoning corresponding to the proposed route; and

wherein displaying to the user the text explanation relating to the note is responsive to receiving an affirmative election to display the reasoning corresponding to the proposed route.

18. The system of claim 10, wherein correlating the delay information with the preselected statistical limits to determine whether the delay information should be used to update the database comprises:

determining whether the potential causes of delay corresponding to the delay information are within the preselected statistical limits;

responsive to a determination that the potential causes of delay corresponding to the delay information are within the preselected statistical limits, updating the database with the delay information including updating driving times corresponding to the delay information;

responsive to a determination that the potential causes of delay corresponding to the delay information are not within the preselected statistical limits:

performing a root cause analysis; and

updating the database with the delay information based on the root cause analysis.

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